

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY

FOREST INSECT INVESTIGATIONS

DAMAGE BY AMBROSIA BEETLES
TO SITKA SPRUCE AND OTHER HOSTS IN THE SPRUCE PRODUCTION AREAS
OF WASHINGTON AND OREGON

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DAMAGE TO SITKA SPRUCE LOGS AND CANTS BY BORING INSECTS

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Extracts from W.E. Glaedinning, report on
DAMAGE BY AMBROSIA BEETLES
TO SITKA SPRUCE AND OTHER HOSTS IN THE SPRUCE PRODUCTION AREAS
OF
WASHINGTON AND OREGON.

Reported to Forest Service by Signal Corps in May 1918.

Loss of 1,000,000 feet in Necanum Clatsop district alone.

W.E. Glendinning, Bur. of Ent. detailed on the work from Aug. 25th, to Oct. 25th, 1918.

Data, leads to the point the the attack plentiful in April and May, subsided about the 15th of June.

The greater part of the damage was done by *Xyloterus bivittatus* Kirby

Gnathotrichus sulcatus Lec. also present but not until later in the season. Attacks recorded in Aug. Sep. and Oct. in stumps and slash. A preference was shown for the hemlock, when ever it was available.

In Sep. *Platypus wilsoni*, were found, attacks confined to Hemlock.

Economic importance during the months of April May and June. and it is probable that the heavy attack does not last more than 5 or 6 weeks.

Hosts Trees.

Sitka spruce ----- *Xyloterus bivittatus*; *Gnathotrichus sulcatus*.
Western Hemlock --- *Gnathotrichus sulcatus*; *Platypus wilsoni*.
Douglas fir ----- *Gnathotrichus sulcatus*; *Xyloterus bivittatus*.
Western Red Cedar-- No beetles noted.

Xyloterus bivittatus Kirby

Records extend from first egg to last pupae. Sep. 12th Oct. 24th. 1918. Spruce cants and Douglas fir logs were noted that had been attacked and abandoned earlier in the season. Apparently there may be at least two seasonal generations. Very few attacks were observed during the period of records. Heavy attacks are during the months of ~~May~~ April May, and June.

Gnathotrichus sulcatus Lec.

Records from Larvae to Maximum emergence. Aug 25th to Oct 24th. 1918. Also from 1st attack to first pupae Sep. 5th Oct 25th. Spruce and Douglas fir logs were found that had been attacked and abandoned

during the early part of the season. There may be two generations. Preference was shown for Hemlock whenever available. Heavier attacks no doubt accrued during the spring months.

Platypus wilsoni Sw.

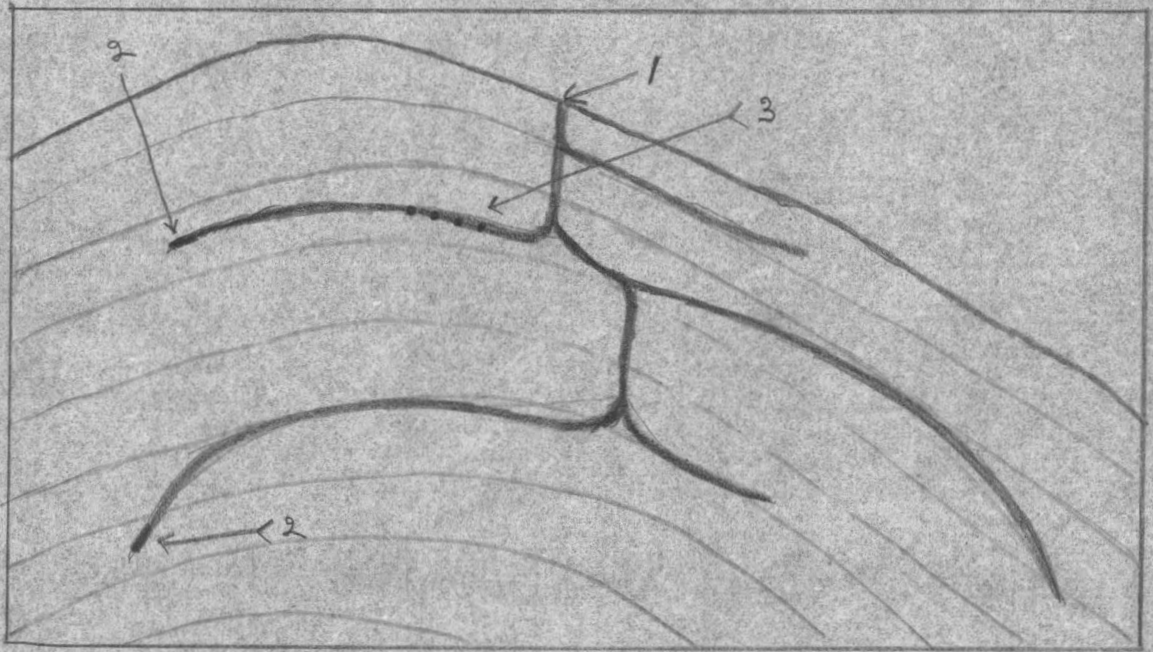
Records from 1st attack to last attack. Aug. 25th Oct 25th. 1918.
Only life history stage found consisted of Parent adults.
Attacks found only in Hemlock.

Miscellaneous Notes.

No difference in the appearance of the work of *Xyloterus* and *Gnathotrichus*, on the surface on the log, both produce the same sort of granular sawdust. The galleries of the *Xyloterus* are larger than the *Gnathotrichus*. The fungus in the galleries of the *Xyloterus* is quite black while in the galleries of *Gnathotrichus* it is browning in color. The work of *Platypus*, can be ~~dist~~ distinguished from the other two species by the shredded frass-like character of the sawdust.

Gnathotrichus sulatus Lec.

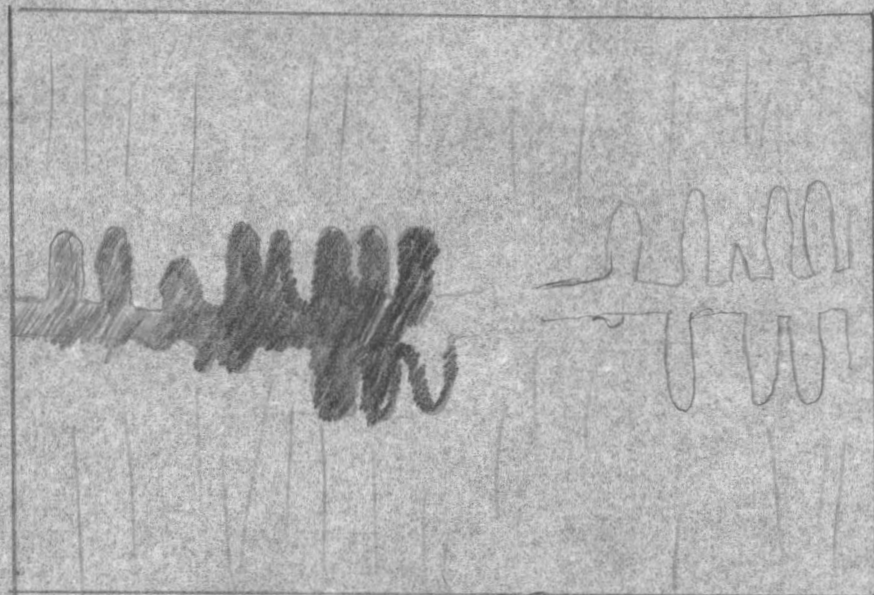
Beetles work in pairs, cutting vertical galleries into the wood to a depth of ~~four to six~~ one to four inches. In some cases they cut to a greater depth in hemlock. Depth seems to be regulated by the thickness of the sapwood.. Never extends into the heart wood. Laterals or breeding galleries are cut at right angles to the main gallery. They extend along the grain of the wood on either or both sides. Egg niches are cut along both sides of the laterals, at intervals of $\frac{1}{4}$ inch and they alternate on each side. These niches are cut just a short time before the eggs are laid. Egg niches are but little larger than will allow the entrance of the egg. The enlargement is done by the larvae. The work of cutting the galleries seems to be done by the female, the male removing the sawdust to the outside. Approximately 30 days elapse between the attack by the parent adult and the depositing of the eggs. The egg niches are sealed after depositing the egg, with sawdust, made into a gummy mass by some secretion. This bars the entrance of the black fungus. In 10 to 15 days the eggs hatch and the larvae at once begin to enlarge the pupal cell. It is evident that the larvae lives on the fibre of the wood. Life of the larvae 16 to 20 days.



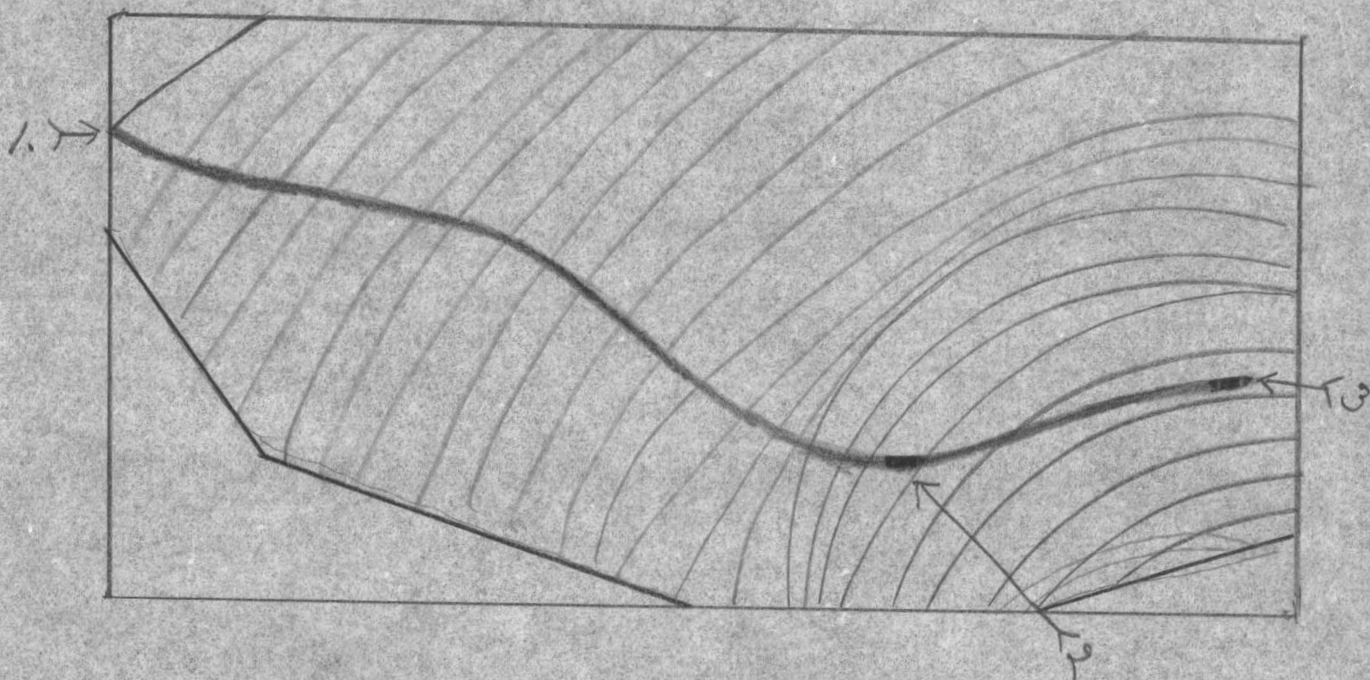
Gnathotrichus sulaatus Lec.

Cross section of Spruce log showing arrangement of galleries:

1. Entrance
2. Parent adults showing position where they were found when log was uncovered.
3. Egg notches.



Section of brood galleries of *Gnathotrichus Sulcatus* Lec.



Platypus wilsoni Sw.

Cross section of Hemlock log showing galleries and position
of parent adults when found.

1. Entrance
2. Male.
3. Female.

Insect Control
Airplane Spruce

July 13, 1918.

To: Spruce Production Division, Aircraft
Production Board, Portland, Oregon.

From: U. S. Forest Service, Portland, Oregon.

Subject: Damage to Sitka spruce logs and cants by
boring insects.

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A memorandum on this subject was submitted to the Division on May 20, 1918. Since then actual field work in the Necanicum-Clatsop District and reports from other spruce producing sections of Oregon and Washington have yielded further data on this menace. The situation is briefly as follows:

1. Split spruce or spruce cants, and logs are being damaged by borers (ambrosia beetles) in every spruce-producing section of the Northwest. On June 15, for instance, at least 1/3 of the 4 million feet of the rived spruce in the woods and at the railroad siding in the Necanicum-Clatsop District was infested and the damage was on the increase. Reports and specimens from other districts indicate equally serious damage.

2. This injury occurs in logs as well as cants. It will continue and unless preventive measures are taken will become even more serious as the season advances until some time in September.

3. Infested portions of logs and cants are of no value for airplane stock. The injury is rather hard to detect in fresh rough sawn material, but can readily be noted on cants and logs. Inspection can be helped by special marking of the infested logs or cants before sawing up, and the marking of the lumber just as it leaves the saw. This will call the attention of the inspectors to the need for especial care in

handling the product.

4. As yet the damage in the cants is largely but not entirely confined to the bright sap. It often extends to a depth of from 2 to 4 inches from exposed inner sap surfaces as well. The same injury is being done now to the bright sap in logs. As the season advances, injury in logs to a depth of 8 to 10 inches by a similar borer is practically certain to occur if the logs are exposed to infestation. This injury to the inner sap of logs may become as common as the present injury to bright sap.

5. Logs and cants now infested should be promptly utilized to arrest further damage by the borers already in them. Much of the borer activity can be arrested by throwing the infested material in water.

6. Injury to logs and cants can be largely prevented by:

- (a) Removal from the woods immediately after felling during the danger period, namely from May 1 to October 1. Three days of exposure in the woods may be sufficient to result in heavy infestation.
- (b) Immersion in water immediately after cutting until removal to the mill.
- (c) Thorough spraying of logs and cants with a kerosene-creosote mixture immediately after cutting, as described later. This is a preventive measure, and is not effective as a remedial agent in material already infested.

7. Waste material from infested cants and green lumber rejected because infested, constitutes a menace to other green lumber or logs in the same vicinity, especially if left until the following spring. Continuance of the prompt use or burning of waste at the Cut-up Plant is urgently recommended.

8. Because of the large number of borers now breeding in debris from

this year's logging operations, the problem will become more acute in the adjacent areas logged next year.

9. The damage has so far been largely in spruce. It may also appear in Douglas fir, although probably not to the same extent since fir is usually moved promptly from stump to mill.

Study of the Problem and its Significance

Subsequent to the transmission of the original memorandum on this subject on May 20, 1918, reports of damage by ambrosia beetles have continued to come in from the various spruce-producing regions in Oregon and Washington, so that it is now definitely known that the menace is of wide-spread extent. In order to get first-hand information on the problem, Forest Examiner A. J. Jaenicke of this office spent ten days in the Necanicum-Clatsop District during the middle of June, visited the various camps, and with the assistance of members of the Division, as well as civilians, inspected a great many of the cants lying in the woods and at the siding. This field study confirmed the information submitted in the memorandum of May 20.

Early in July, the writer had a conference in Portland with Messrs. J. M. Miller and F. C. Craighead of the Bureau of Entomology. These men, under the direction of Dr. A. D. Hopkins (in charge of the Branch of Forest Insect Investigations, Washington, D. C.) devote their entire time to timber insects, and are therefore well informed on a problem such as this. In making the recommendations for action submitted herewith, the conclusions reached in this conference have been followed, and the publications of the Bureau of Entomology have been used freely. The recommendation for the use of the kerosene-cresote mixture as a preventive measure has as its basis experimental work done under the direction of Dr. A. D. Hopkins.

If the Spruce Production Division desires further information and assistance on the whole situation, the Portland office of the Forest Service and the Pacific Coast representative of the Bureau of Entomology at Ashland, Oregon, stand ready to furnish it.

As is evident from the detailed discussion in the remaining portion of this memorandum, this problem is worthy of prompt and serious consideration by the Spruce Production Division. The borers do their damage so promptly after cutting, and the injury can so easily escape the attention of inspectors not fully informed about it, that only the closest cooperation from both the woods and the mill will enable the Division to keep the logs reasonably free from the borers, and to prevent damaged lumber from being included in shipments.

At the camps there is a tendency among the civilian foremen and superintendants to consider the damage as being either unavoidable, or perhaps of little consequence because the damage so far has been largely confined to the bright sap, and to believe that spruce logs will be relatively free from attack. As is well known, bright sap frequently enters into the final lumber, and no assurance can be given that a more dangerous borer, capable of entering the wood to a depth of 8 to 10 inches, will not be encountered. To still further complicate matters, this second borer is exceedingly apt to be confused with the other in the early stages of attack.

Cause of the Damage

A group of borers known as ambrosia beetles have for many years caused trouble in Douglas fir, hemlock, and spruce logging operations in the Northwest, by infesting the round timber as soon as it is cut. Thus far only one genus of these borers has been found in the spruce logs and cants, and this is a species of *Gnathotricus*.* The beetles which are now attacking

* This identification is only tentative. For definite determination specimens of the borer have been sent to Dr. A. D. Hopkins, Bureau of Entomology, Washington, D. C.

the felled spruce bred in green windfalls, snowbreaks, etc. of hemlock, spruce and Douglas fir, which were on the ground last spring and summer. To breed successfully, the beetles require green down material or dying trunks. They never enter dead and dry wood, and seldom perfectly healthy trees.

The beetles breed in Douglas fir and hemlock as well as in spruce. In a virgin forest, one of the factors which restrict the number of beetles is the amount of suitable breeding material. Because, therefore, of the large quantities of debris of various species on the 1918 spruce cutting areas, the beetles will have an opportunity to increase enormously in numbers on these areas. This means that in 1919 the spruce and Douglas fir cut in adjacent areas will be subject to even greater attack than in 1918.

Inasmuch as there is a possibility that damage from another and very much similar borer will come to light later in the season, the injury from which is far more serious than the insect just described, certain distinguishing characteristics are here given. This second borer is also an ambrosia beetle, but belongs to the genus *Platypus*. The layman can generally distinguish it from *Gnathotricus* by the following characteristics:*

1. Slightly but distinctly larger entrance holes.
2. Minute splinter-like frass seen in the crevices below the entrance holes in contrast to the meal-like boring dust of *Gnathotricus*.
3. Larger size. The average length of *Gnathotricus* is only $1/8$ of an inch while the *Platypus* beetle is at least $1/5$ of an inch in length.

*These data as well as the life history information in the subsequent paragraph is subject to verification by Dr. A. D. Hopkins.

4. Flattened body of Platypus in contrast to the cylindrical body of Gnathotricus.

These insects begin their flight and attack early in May and continue this activity until some time in September. Upon emerging from debris in the spring and summer they fly to new green material, and begin their galleries immediately. Along these galleries the beetles lay their eggs. The larvae hatching from these eggs probably do not develop into full-grown beetles until the following spring when they emerge, thus completing the cycle. Ordinarily, the beetles in an infested log lying beside a log free from insects will not emerge to infest the neighboring log until the following season. There is some evidence that a few species of these ambrosia beetles have two generations each year, but with our present information as a basis this cannot be fully verified.* Whether these species have one generation or two, the fact remains that the danger period exists as long as the insects are found in flight in any considerable numbers. This period is from early May to about the middle of September.

Character of the Damage

Briefly this consists in the perforation of the wood by holes $1/8$ to $1/16$ inch in diameter, to a depth of a maximum of 3 or 4 inches in the case the beetle which has done most of the damage thus far, and to a depth of 8 to 10 inches by the yet unreported Platypus.

In attacking spruce cants, the insects enter the wood as follows, the most common mode being given first:

*Studies by the Dominion Government in British Columbia indicate this to be true.

1. Through the bark-covered surface.
2. Directly into the exposed three or four inch layer of bright sap which lies next to the bark.
3. Directly into the exposed inner sapwood.

The ambrosia beetle does not therefore enter the wood only by way of the bark, but attacks the exposed faces of the cants as well. When the beetles first began their attacks in May, they confined their attention to the bark-covered and exposed bright sap, but as the season progresses, the infestation of the remaining sapwood is becoming more and more common. As many as 100 entrance holes for every square foot of bark surface or exposed bright sap were frequently found. In the remaining portion of the exposed sapwood, the infestation was never more than one-half of this. The end faces of the cants are not entered.

After the fairly vertical galleries have penetrated the wood to a depth of from a minimum of one inch to a maximum of four inches, they branch out for several inches at right angles to the original gallery. It does not require a very heavy infestation, therefore, to badly riddle the wood and make it unsuitable for any purpose whatever. Should Platypus begin its activity in spruce, this damage would of course be tremendously greater since the holes penetrate far deeper.

Spruce in the form of cants offers the greatest possible surface area to attack by ambrosia beetles. It is understood that in the future no extensive riving will be done. Gnathotricus will therefore be forced to confine its attention to the bright sap of the logs, no exposed inner sapwood being available. As a consequence, logging in the round will result in a reduction of the losses by the ambrosia beetle. But the possibility of attacks by Platypus should not be overlooked.

Ambrosia beetles work with great rapidity. Repeatedly it was observed that spruce was attacked within three or four days after cutting. Within four or five hours the beetle can easily penetrate to a depth of an inch and even more. This

emphasizes the necessity of prompt measures in avoiding injury to airplane spruce in the woods.

The first evidence that these beetles are at work is the appearance of small piles of white sawdust. On the dark-colored spruce bark these accumulations of frass are exceedingly conspicuous, and because of the irregularities in the bark surface, this sawdust sticks pretty well to the bark. When the bare wood is attacked the color of the wood and the color of the sawdust offer very little contrast. In addition the sawdust piles are easily blown away or washed off. As a consequence the fact that the beetles are entering the exposed wood in considerable numbers has frequently been overlooked.

The beetle brings into the gallery the spores of a certain fungus known as ambrosia. In the course of a week or two the fungus develops sufficiently from these spores to form a glistening black layer over the walls of the galleries. This fungus serves as food for the adult beetles and the larvae, and is not responsible for wood decay of any kind.

Extent and Distribution of the Damage

The only spruce-cutting area actually visited by the writer is the Necanicum-Clatsop District. Specimens of the work of the ambrosia beetle, and in some cases rather definite estimates of the amount of infestation, have come in from the more important spruce operations in Oregon and Washington. In the absence of actual study of these other Districts it is impossible to accurately estimate the extent of the damage, but the indications are that it is as heavy as in Clatsop County. Only careful examination of the cants and logs will reveal the true amount of infestation. Casual and hasty inspection by men inexperienced with the character of the work of these borers, invariably leads to an under estimate of the injury.

In Clatsop County it was found that on a given cutting area of a few thousand acres in extent, the damage is by no means evenly distributed. On

parts of such an area, cants which have been lying in the woods since early spring were still free from borers in late June, while within half a mile a considerable proportion of the cants were heavily loaded with the insects. In some cases, for instance, the cants on the high ground seemed immune while material lying in the colder and shaded sites was full of ambrosia beetles. Irregularity in the emergence of the beetles from the debris infested in 1917, and the irregular distribution of this old breeding material are conditions which may partially explain this unevenness in the attacks by the borers. Cants brought to the various railroad sidings near Clatsop were frequently attacked within a few days after their arrival. This was true in a number of cases where cants had previously been immune in their original location in the woods. The borers are especially attracted to large accumulations of green breeding material, and this accounts for their frequency along the railroad sidings.

In many instances spruce is now being cut in regions where no considerable felling of spruce or other species took place last year within a radius of four or five miles. As a consequence, the ambrosia beetles have thus far been restricted by the limited quantity of green debris resulting from accidents in the forest, such as fire injury, wind-throw of living trees, snow-break, etc. The present logging operations are furnishing green breeding material sufficient in quantity to enable the insects to increase enormously. If, therefore, spruce is cut adjacent to the 1918 operations next year, the ambrosia beetle problem is likely to be of far greater importance in 1919 than it is in 1918. This year the borers are emerging in insufficient numbers to attack all the felled material, limited as they have been by the small amount of desirable green stuff. The same thing holds true for the Douglas fir areas. In brief, therefore, the amount of infestation occurring now in the various portions of Oregon and Washington in spruce

and Douglas fir operations is by no means a criterion of what can be expected next year.

Remedial Measures

Remedial measures, that is the treatment of material already infested, are practically restricted to the immersion of the cants and logs in water for several days to drown out the borers. If this can not be done, nothing remains but prompt utilization. The question has been asked whether the beetles continue their work in the sawed lumber of the larger dimensions. Before the lumber was kiln-dried at the Cut-up Plant, it was easily possible to ship spruce stock containing living beetles which would continue their activity in transit. Subjected to a temperature of 170 degrees Fahrenheit for a period of 15 days as spruce lumber now is, no beetles or larvae remain alive in the kiln-dried lumber.

Because any spray used on the cants or logs would have to first penetrate the bark and then the tortuous galleries of the borer, it does not seem feasible to treat the infested material in its original position in the woods, even if it were possible to reach all portions of it with a liquid. No doubt a number of the beetles would be killed by such a treatment, especially those borers which entered directly into the exposed wood surfaces, but there probably would not be a sufficient reduction in the entire infestation to serve the purpose. Enough beetles would remain alive even after thorough spraying to make it necessary to reject the portions containing the remaining healthy beetles. The kerosene-creosote mixture described in a later section of this memorandum has thus far given the best results in such cases, but for the treatment of bark covered logs and cants already infested, its wholesale use is not recommended.* That such a measure would be success-

*Mr. F. C. Craighead of the Bureau of Entomology who has experimented with a large number of sprays for the treatment of infested and uninfested wood-boring, agrees with the writer that the spraying or painting of infested spruce logs and cants is not feasible.

ful even if the logs and cants were peeled cannot be definitely assured.

Preventive Measures, Exclusive of the Kerosene-Creosote Treatment.

The prompt removal of the spruce logs and cants within a few days after cutting is really the only safe way to prevent damage by the borers. In a number of instances in Clatsop County the ambrosia beetles entered the cants and logs within 48 hours after they were out. Everywhere the beetles exhibited a decided preference for hemlock, but in no way did there seem to be any relation between the presence or absence of hemlock and attacks by the borers on the felled spruce.

To avoid damage to spruce on these cutting areas in which borer attacks are severe, it seems necessary to stop the felling of spruce temporarily whenever it cannot be hauled out as fast as it is cut. It is a dangerous practise to allow felled spruce to remain in the woods for a few weeks or more during the period when the beetles are flying in large numbers.

If the spruce cannot be hauled out of the woods promptly, the next best thing is to place it into any body of water which can be reached, and allow the spruce to remain there until it can be hauled to the mill.

Whether the spruce is hauled out or thrown into water, it should be remembered that the danger of damage by ambrosia beetles is confined to a restricted period. This period will vary somewhat with the various localities in Oregon and Washington. It rarely begins earlier than May 1, and probably does not continue longer than until October 1. The beginning and ending of the period of active attack for each cutting area will have to be determined right on the ground.

The above discussion applies equally well to Douglas fir.

A measure that has been suggested is the barking of the logs and cants. The absolute ineffectiveness of this plan has been fully demonstrated in the field.

Use of the Kerosene-Creosote Mixture

A recent conference with a member of the Bureau of Entomology* brought to light the fact that of all the various so-called repellants which have been under experimentation by that Bureau during the past few years, a mixture of kerosene and creosote gives satisfactory results, and for this purpose is even better than the kerosene emulsion-sodium arsenate mixture, copper sulphate, or any other repellant.

The mixture is prepared by mixing four parts of kerosene with one part of a good grade of creosote. When these two materials are mixed, a heavy precipitate of a thick syrupy nature falls to the bottom. The remaining liquid is not very much heavier than water and is of a dark copper color. This lighter liquid is poured off and used as a spray.

In using this material the important feature is to cover the logs and cants thoroughly. Any small unsprayed areas will be subject to subsequent attack by the borers. The best success has been had with this mixture when the wood has actually been dipped into it. Since dipping is not feasible, spraying seems to be the next best method. Painting of the bark-covered surface will not meet with success, because of the scaly bark of the spruce which is either rubbed off or loosened by the brush, leaving untreated surfaces for the easy access of the beetles. A fairly fine spray will reach to some extent below the bark scales, and facilitates the covering of those portions of the logs or cants lying close to the ground.

The most feasible spray pump is one of the portable tank pumps which is carried on the operator's back. This pump is known as the "Perfection" and costs \$7.00. The capacity of the tank is 3 gallons, but only 2 gallons of the spray should be placed in it in order to allow space for the

*Mr. F. C. Craighead of the Washington Office of the Bureau.

air compression. When empty the pump weighs approximately 15 pounds, and slightly over 30 pounds with 2 gallons of spray. It can be purchased from the Charles H. Lilly Company, 174 Front Street, Portland, Oregon, and perhaps from several other dealers in the city.

The mixture is of course inflammable, but since it volatilizes to some extent with exposure and inasmuch as no large quantities are used on the material to be protected, this objection is not as serious as it may seem at the outset.

Kerosene and creosote are two materials which are exceedingly objectionable to the borers, and its action is in the nature of repellant in that the borers avoid wood or bark covered with it.

As has already been stated, this spray is not satisfactorily effective for the treatment of infested spruce or Douglas fir, and therefore it is of first importance that the spray be applied before the borers have an opportunity to enter the wood or bark.

Handling of Infested Material at the Cut-up Plant

It is not at all difficult to discover the small entrance holes of the borers in the infested logs or cants. The small piles of saw-dust are the most conspicuous indication of the activity of the beetle, but when the attacked material is moved, much of the saw-dust falls off. Because it is so easy to see infestation in the unsawed spruce or Douglas fir, and since it is quite difficult in some cases to discover the damage in the unplanned lumber, it seems exceedingly desirable that some system be adopted of marking the lumber derived from the outside portions of the infested logs or cants just as it leaves the saw. By marking the lumber in a characteristic way, the inspectors are made aware of the necessity of special examination for insect damage in certain pieces. When the ambrosia beetle galleries are quite new, they have not

yet taken on that blackened appearance so characteristic of older ambrosia beetle work. This recently infested lumber is therefore not easy to single out. That any aid to careful inspection in this respect is desirable is also indicated by the fact that a few holes in the surfaces of a piece of lumber several inches in thickness may indicate invisible damage of greater severity.

The writer spent two days at the Cut-up Plant during the latter part of June and endeavored to acquaint as many men as possible with the nature of this problem, but there are still many of the inspectors who have no knowledge of this matter, in spite of the fact that infested cants were at that very time being unloaded at the mill.

Slabbing and rejected material of all kinds is being promptly disposed of at the Cut-up Plant. The continuation of this practise is essential since beetles emerging from infested spruce or Douglas fir would be a decided menace to the logs and cants lying near the mill for a period of more than a week or two.

(Signed) A. J. JAENICKE.

Forest Examiner.

Approved: July _____, 1918.

(Signed) GEO. H. CECIL

District Forester.